Controlling chemical reactivity by confinement effects

Nature has long impressed chemists with its ability to stabilize ephemeral chemical species, perform chemical reactions with unprecedented rates and selectivities, and synthesize complex organic molecules and exquisite inorganic structures seemingly effortlessly. What the natural systems consistently exploit is the aspect of confinement. In contrast, the use of confinement effects in a synthetic setup [1] is relatively rare; examples include “on-water” catalysis [2] and reaction acceleration within molecular containers [3]. In this talk, I will discuss our studies on the synthesis and properties of nanomaterials and molecules capable of confining other, smaller molecules. These nanomaterials include colloidal crystals [4] and nanoporous metals [5], featuring confined spaces with dimensions of 1–20 nm; the cavities of molecular containers are smaller, typically in the subnanometer size regime. I will describe how these confined spaces can be generated reversibly using light [6,7] and magnetic fields [8], paving the way toward controlling chemical reactivity using external stimuli. Finally, I will focus on the cavities of coordination cages and discuss how we utilized them to tune the wavelength of azobenzene photoisomerization across the entire visible range [9].

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